PHF21A gene

PHD finger protein 21A

Normal Function

The *PHF21A* gene (also known as *BHC80*) provides instructions for making a protein involved in a process called histone demethylation, which helps control (regulate) gene activity. Histones are structural proteins that attach (bind) to DNA and give chromosomes their shape. The removal of a molecule called a methyl group from histones (histone demethylation), helps turn off (repress) certain genes. The PHF21A protein binds to histones that have already been demethylated, which researchers speculate helps keep the histone demethylated and the genes turned off. The PHF21A protein appears to be particularly important in regulating genes involved in development of nerve cells in the brain and structures of the face.

Health Conditions Related to Genetic Changes

Potocki-Shaffer syndrome

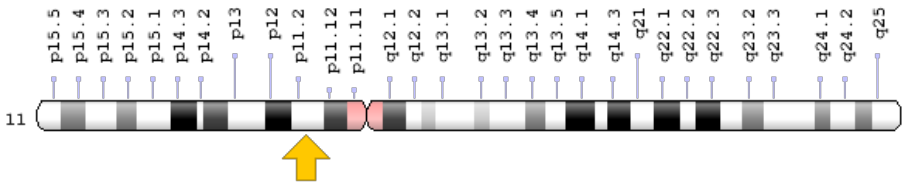
A genetic change resulting in the deletion of the *PHF21A* gene causes a condition called Potocki-Shaffer syndrome. People with this condition have enlarged openings in two bones that make up much of the top and sides of the skull (enlarged parietal foramina) and multiple noncancerous bone tumors (osteochondromas). Other signs and symptoms seen in some people with Potocki-Shaffer syndrome include intellectual disability, developmental delay, distinctive facial features, vision problems, and defects in the heart, kidneys, and urinary tract.

Potocki-Shaffer syndrome (also called proximal 11p deletion syndrome) is caused by a deletion of genetic material from the short (p) arm of chromosome 11. In people with this condition, a loss of the *PHF21A* gene within this region is responsible for intellectual disability and distinctive facial features. The deletion likely leads to a reduction in the amount of PHF21A protein. It is thought that the resulting disruption of histone demethylation alters the activity of genes involved in neuronal and facial development, leading to intellectual disability and distinctive facial features. The loss of other genes in the same region of chromosome 11, *ALX4* and *EXT2*, underlie the enlarged parietal foramina and multiple osteochondromas, respectively. The loss of additional genes in the deleted region likely contributes to the other features of Potocki-Shaffer syndrome.

Chromosomal Location

Cytogenetic Location: 11p11.2, which is the short (p) arm of chromosome 11 at position 11.2

Molecular Location: base pairs 45,929,319 to 46,121,434 on chromosome 11 (Homo sapiens Annotation Release 108, GRCh38.p7) (NCBI)



Credit: Genome Decoration Page/NCBI

Other Names for This Gene

- BHC80
- BHC80a
- BM-006
- BRAF35-HDAC complex protein BHC80
- BRAF35/HDAC2 complex (80 kDa)
- KIAA1696

Additional Information & Resources

Educational Resources

- Genomes (second edition, 2002): Chromatin Modifications and Genome Expression
  https://www.ncbi.nlm.nih.gov/books/NBK21137/#_A6866_
- Madame Curie Bioscience Database (2000): Basic Features of Chromatin Structure
  https://www.ncbi.nlm.nih.gov/books/NBK45032/#_ch4689_s3_

Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28PHF21A%5BTIAB%5D%29+OR+%28PHD+finger+protein+21A%5BTIAB%5D%29%29+OR+%28BHC80%5BTIAB%5D%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+3600+days%22%5Bdp%5D

OMIM

- PHD FINGER PROTEIN 21A
  http://omim.org/entry/608325

Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology
  http://atlasgeneticsoncology.org/Genes/GC_PHF21A.html
- HGNC Gene Family: PHD finger proteins
  http://www.genenames.org/cgi-bin/genefamilies/set/88
- HGNC Gene Symbol Report
  http://www.genenames.org/cgi-bin/gene_symbol_report?q=data/hgnc_data.php&hgnc_id=24156
- NCBI Gene
  https://www.ncbi.nlm.nih.gov/gene/51317
- UniProt
  http://www.uniprot.org/uniprot/Q96BD5

Sources for This Summary

- Kim HG, Kim HT, Leach NT, Lan F, Ullmann R, Silahtaroglu A, Kurth I, Nowka A, Seong IS, Shen Y, Talkowski ME, Ruderfer D, Lee JH, Glotzbach C, Ha K, Kjaergaard S, Levin AV, Romeike BF, Kleefstra T, Bartsch O, Elsea SH, Jabs EW, MacDonald ME, Harris DJ, Quade BJ, Ropers HH, Shaffer LG, Kutsche K, Layman LC, Tommerup N, Kalscheuer VM, Shi Y, Morton CC, Kim CH, Gusella JF. Translocations disrupting PHF21A in the Potocki-Shaffer-syndrome region are associated with intellectual disability and craniofacial anomalies. Am J Hum Genet. 2012 Jul 13; 91(1):56-72. doi: 10.1016/j.ajhg.2012.05.005. Epub 2012 Jul 5.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/22770980
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3397276/
- Labonne JD, Vogt J, Reali L, Kong IK, Layman LC, Kim HG. A microdeletion encompassing PHF21A in an individual with global developmental delay and craniofacial anomalies. Am J Med Genet A. 2015 Dec;167A(12):3011-8. doi: 10.1002/ajmg.a.37344. Epub 2015 Sep 3.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/26333423

- Lan F, Collins RE, De Cegli R, Alpatov R, Horton JR, Shi X, Gozani O, Cheng X, Shi Y. Recognition of unmethylated histone H3 lysine 4 links BHC80 to LSD1-mediated gene repression. Nature. 2007 Aug 9;448(7154):718-22.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/17687328
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2702779/
- Montgomery ND, Turcott CM, Tepperberg JH, McDonald MT, Aylsworth AS. A 137-kb deletion within the Potocki-Shaffer syndrome interval on chromosome 11p11.2 associated with developmental delay and hypotonia. Am J Med Genet A. 2013 Jan;161A(1):198-202. doi: 10.1002/ajmg.a.35671. Epub 2012 Dec 13.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/23239541
- OMIM: PHD FINGER PROTEIN 21A
  http://omim.org/entry/608325

Reprinted from Genetics Home Reference:
https://ghr.nlm.nih.gov/gene/PHF21A

Reviewed: May 2016
Published: March 21, 2017

Lister Hill National Center for Biomedical Communications
U.S. National Library of Medicine
National Institutes of Health
Department of Health & Human Services